General Instructions for Diagnostic and Tune-Up Analyzer

INTRODUCTION

Proper automobile engine performance has become increasingly important while at the same time, the cost of maintenance has risen to a point where the average motorist cannot afford to pay to have a professional mechanic perform the needed services. In addition, the continuing energy crisis and accompanying rise in gasoline prices make it a decided advantage for each car owner to maintain his car in the best possible operating condition in order to obtain the greatest return for each dollar in operating costs.

The purpose of this instruction manual is to provide anyone with the needed expertise to perform necessary adjustments and services to keep his car in peak running condition. Once understood, the unfamiliar complexities of car engine tune-ups become relatively simple. The few basic tools available through your local auto parts dealer for a nominal cost needed to do the job will pay for themselves many times over in succeeding years.

Since it is impractical to include specific information on each and every make and model of vehicle manufactured, we may use generalities in many portions of this manual. So that those who wish to go beyond the limits of this handbook may have a starting point for additional reference. However, it should be noted that the specifications contained in the vehicle owner's manual of your car are indispensable for a safe and satisfactory tune-up. If you have lost the owners manual, ask your car dealer or local service department for another copy before you try to do anything to your engine.

• LISTING OF MODELS

The following pictures illustrate the various precision engine analyzers that we manufacture. All of them are specially designed to trouble-shoot gasoline engines with 12-volt standard or electronic ignition systems. Try to find your new diagnostic analyzer and the functions it can perform from below:

3010 Dwell/Tach tester

Functions:

TACH:	0-2400 RPM	4 Cyl.
	0-1600 RPM	6 Cyl.
	0-1200 RPM	8 Cyl.
DWELL:	0-90°	4 Cyl.
	0-60°	6 Cyl.
	0-45°	8 Cyl.

3012 6-Function analyzer

Functions:

HI-TACH:	0-9000 RPM	4 Cyl.
	0-6000 RPM	6 Cyl.
	0-4500 RPM	8 Cyl.
LO-TACH:	0-2400 RPM	4 Cyl.
	0-1600 RPM	6 Cyl.
	0-1200 RPM	8 Cyl.
DWELL:	0-90°	4 Cyl.
	0-60°	6 Cyl.
	0-45°	8 Cyl.
HI-VOLT:	0-24 V	
LO-VOLT:	0-1.6 V	
POINT:	OK/BAD	

3020 7-Function anaylzer

Functions:

HI-TACH:	0-6000 RPM	
LO-TACH:	0-1600 RPM	
DWELL:	0-90°	4 Cyl.
	0-60°	6 Cyl.
	0-45°	8 Cyl.
AMP:	0-80 AMP	
HI-VOLT:	0-20 V	
LO-VOLT:	0-1 V	
POINT:	OK/BAD	

3022 7-Function analyzer with inductive pickup

Functions:

HI-TACH:	0-6000 RPM	
LO-TACH:	0-1600 RPM	
DWELL:	0-90°	4 Cyl.
	0-60°	6 Cyl.
	0-45°	8 Cyl.
OHM:	0-300K OHM	
HI-VOLT:	0-20 V	
LO-VOLT:	0-1 V	
POINT:	OK/BAD	

3024 10-Function analyzer with inductive pickup

Functions:

HI-TACH:	0-6000 RPM	
LO-TACH:	0-1600 RPM	
DWELL:	0-90°	4 Cyl.
	0-60°	6 Cyl.
	0-45°	8 Cyl.
HI-OHM:	0-50K	
LO-OHM:	0-500	
HI-VOLT:	0-32V	
VOLT:	0-16V	
LO-VOLT:	0-1.6V	
AMP:	0-80 AMP	
POINT:	OK/BAD	

3030 6-Function bench analyzer

Functions:

TACH:	0-2000 RPM	
DWELL:	0-90°	4 Cyl.
	0-60°	6 Cyl.
	0-45°	8 Cyl.
AMP:	0-160 AMP	
HI-VOLT:	0-20 V	
LO-VOLT:	0-1 V	
POINT:	OK/BAD	

3032 10-Function bench analyzer with inductive pickup

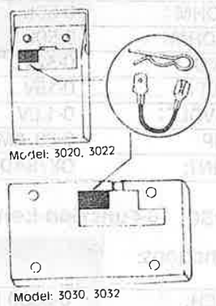
Functions:

HI-TACH:	0-6000 RPM	
LO-TACH:	0-1600 RPM	
DWELL:	0-90°	4 Cyl.
	0-60°	6 Cyl.
	0-45°	8 Cyl.
HI-OHM:	0-200K OHM	
LO-OHM:	0-2K OHM	
HI-AMP:	0-100 AMP	
LO-AMP:	0-10 AMP	
HI-VOLT:	0-20 V	
LO-VOLT:	0-2 V	
POINT:	OK/BAD	

- **ELECTRONIC IGNITION ADAPTORS**

The following adaptors are supplied with model 3020, 3022, 3024,3030, and 3032 analyzers to help you make dwell or tach connections to late model cars equipped with electronic ignition systems.

The adaptors are stored in a trough inside the rear compartment. Always put the adaptors in the trough after use to prevent them from falling into the instrument housing through holes on compartment wall.



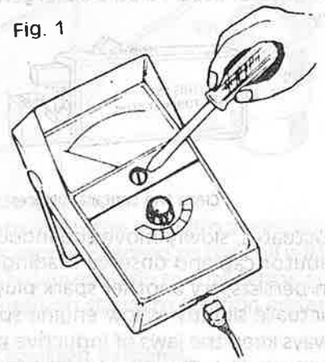
Caution:
To avoid bodily injuries and damages to the analyzer, be very careful when working under the hood. Always keep your arms, hands, the analyzer, and especially its lead wires and clips away from moving engine parts and hot surfaces. Smoking is also strictly forbidden.

- **PRELIMINARY ANALYZER ADJUSTMENT**

Before each use, analyzer should be checked and adjusted to assure accuracy.

1. Hold analyzer upright or place on a level horizontal surface. Check that the needle indicates "0" on RPM scale.
2. If analyzer does not indicate "0", turn the zero-adjust screw on front of case with a screwdriver until the needle indicates "0".

Fig. 1

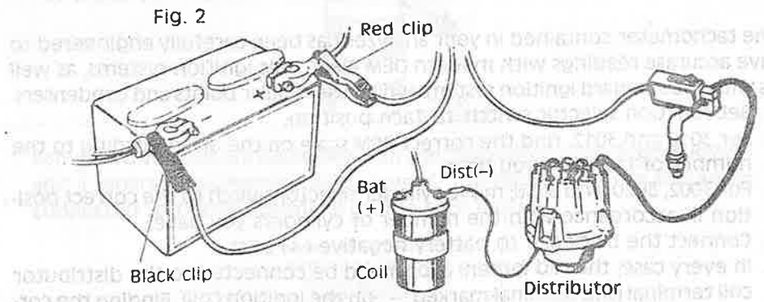


- **TACHOMETER FUNCTION**

A. Connection of analyzer with an inductive pickup (3022, 3024, 3032):

1. Rotate function selector switch to high or low tach position as desired.
2. Clamp the inductive pickup onto any spark plug cable, preferably as close to the spark plug as possible without touching any hot metal part. Make sure that the side marked 'THIS SIDE TOWARD PLUG' faces the spark plug.
3. Connect red and black power lead clips to vehicle's battery, observing proper polarity (black to negative, red to positive, regardless of battery ground).

Fig. 2



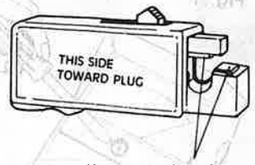
You are now ready to read the engine RPM on the high or low RPM scale as selected regardless of the number of cylinders.

Note:

If the needle does not move or gives an unstable reading when testing engine RPM, proceed as follows:

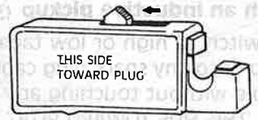
1. Check that the jaws of inductive pickup is fully closed and with the right side facing the spark plug.
2. Check that the contact surfaces of the upper and lower ferrite cores are clean without dirt or grease. Use a volatile detergent to clean the contact surfaces if necessary.

Fig. 3



Clean the contact surfaces

3. If the needle still fluctuates, slowly move the inductive pickup along the cable towards distributor cap and observe reading.
4. If needle fluctuation persists, try another spark plug cable.But it is normal for the needle to fluctuate slightly at low engine speed.
5. When not in use, always keep the jaws of inductive pickup open by pulling back the 'latch' as shown below. This is to prevent ferrite cores from breaking when accidentally crashed or dropped.



Always keep jaws open when not in use

B. Connection of analyzer only with 2 test leads (3010, 3012, 3020, 3030):

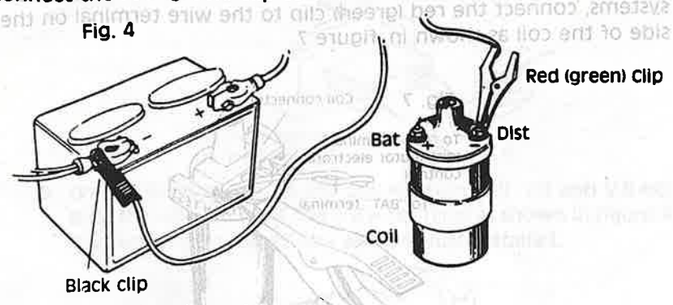
The tachometer contained in your analyzer has been carefully engineered to give accurate readings with modern OEM electronic ignition systems, as well as with the standard ignition systems which use regular points and condensers.

1. Set function selector switch to Tach position.
2. For 3010 and 3012, find the correct RPM scale on the dial according to the number of cylinders you have.
3. For 3002, 3020, and 3030, move cylinder selector switch to the correct position in accordance with the number of cylinders you have.
4. Connect the black clip to battery negative (–) post.
5. In every case, the red (green) clip should be connected to the distributor coil terminal (the terminal marked '–' on the ignition coil). Finding the correct connection point, and making the connection, requires different approaches for different cars. However, the following information should be of considerable assistance.

5-1. Standard Ignition Systems

Connect the red (green) clip to the '–' terminal of the ignition coil.

Fig. 4



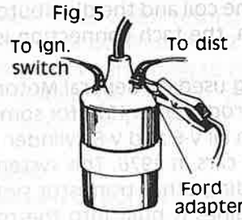
5-2. Chrysler Eletronic Ignitions

The negative coil terminal is the one with a wire leading from the coil to the distributor. This wire is attached to the coil with a standard hex nut. Simply connect the red (green) clip to that terminal, and this is the same coil connection as used on standard ignition systems.

5-3. Ford Electronic Ignition Systems

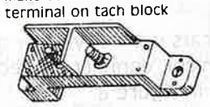
*** Most Ford ignition systems (recent electronic and earlier standard systems as well) use a special "press-on" insulated connector on the two primary terminals of the ignition coil. With these systems, lift the distributor connector and slide the Ford adaptor clip in place as shown in figure 5, then push the connector down on it. Remove when the tests are finished.**

Fig. 5



*** Some Ford vehicles are equipped with the "Autolite Breaker Point System" and a separate connecting block is used. The red (green) clip should be connected to the red terminal on the tach block.**

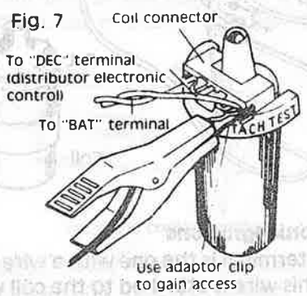
Fig. 6



Ford Autolite system with tach block

* 1975 and later Ford vehicles have a "coil connector" which slips onto the standard coil and prevents contact with the coil terminals. With these systems, connect the red (green) clip to the wire terminal on the TACH side of the coil as shown in figure 7.

Fig. 7

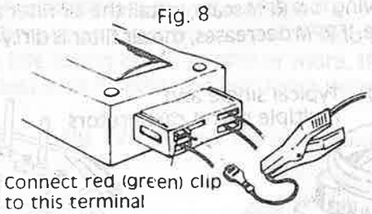


5-4. **General Motors Products**

* The Delco-Remy Magnetic Pulse System is a fully transistorized, pointless system which uses a rotating iron timer and a magnetic pickup assembly in the distributor together with a transistor control unit instead of the conventional points and condenser. This system uses a special ignition coil which is similar in appearance to standard ignition systems coil. The red (green) clip connection is made at the coil in the normal manner.
* The Delcontronic Capacitor Discharge System consists of a magnetic pulse distributor, ignition pulse amplifier and a special ignition coil and distributor cap. Both the coil and the distributor are red so they are easily recognizeable. Again, the tach connection is made at the distributor terminal of the coil.
* The latest system being used by General Motors is the High Energy Ignition (HEI) which was introduced in 1974 for some model cars. In 1975, this system was installed on all V-6 and V-8 cylinder engines and extended to in-line 6 and 4-cylinder cars in 1976. This system is different from other ignition systems, including other transistor systems, in that the ignition coil on V-6 and V-8 engines is built into the top of the distributor cap eliminating the high tension lead wire from coil to distributor on these versions. On in-line 6 and 4-cylinder versions, the coil is mounted on the engine compartment firewall to allow for a lower hood line. These systems all provide a special terminal in the distributor cap for making tach connection.

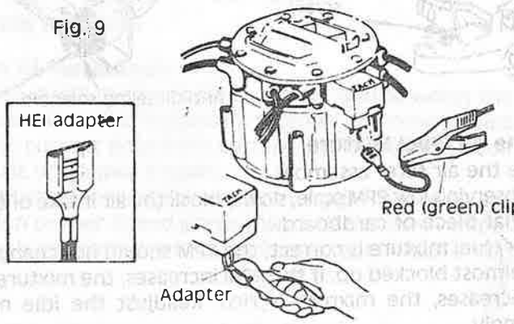
a. On General Motors cars with 4-cylinder and in-line 6-cylinder engines and separate ignition coil, connect the red (green) clip to the open TACH termainal as shown in figure 8.

Fig. 8



b. On the General Motors integral ignition coil V-8 and V-6 HEI systems, slide the adaptor onto the TACH terminal as shown in figure 9. Connect the red (green) clip to the adaptor just installed.

Fig. 9



Note:

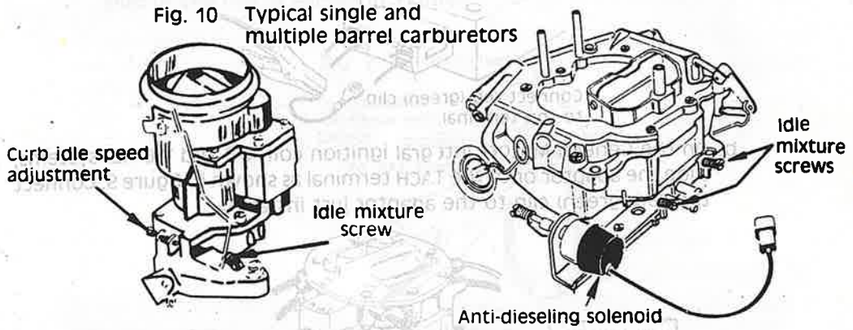
1. 2-Cycle engines produce twice as many ignition sparks as standard 4-cycle automobile engines. Thus, when testing 2-cycle engines, the indicated tachometer reading must be divided by 2 to obtain correct engine speed.
2. For all the following tests pertaining to the use of tachometer function, unless otherwise stated, the engine should be at normal operating temperature and running at idle speed.

C. Carburetor Adjustment

1. Start engine and allow it to warm to normal operating temperature. Shut off engine. Remove air filter.
2. Turn in the idle mixture screw until it is lightly seated. Back the screw out three full turns.
3. Start engine and let it idle for one minute.
4. Set function selector switch to LO-TACH position observing low RPM scale, adjust the idle speed screw to obtain the idle speed specified by manufacturer.
5. Adjust idle mixture by turning the idle mixture screw in or out to obtain an increase in RPM. Readjust idle speed to correct RPM. Repeat these steps until no further increase in RPM is obtainable.

6. While observing low RPM scale, install the air filter and check that RPM does not decrease. If RPM decreases, the air filter is dirty and needs to be cleaned or replaced.

Fig. 10 Typical single and multiple barrel carburetors



D. Testing the Air/Fuel Mixture

1. Remove the air filter assembly.
2. While observing low RPM scale, slowly block the air intake of the carburetor with a flat piece of cardboard.
3. If the air/fuel mixture is correct, the RPM should not change until the intake is almost blocked up. If the RPM increases, the mixture is lean; if the RPM decreases, the mixture is rich. Readjust the idle mixture screw accordingly.

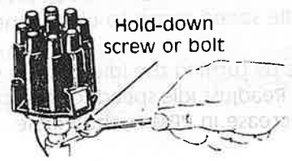
E. Testing the Centrifugal Advance

Caution:

Before performing this test, remove rings and wristwatch from your hands or wear thick gloves to prevent accidental shock hazard.

1. Loosen the distributor hold-down bolt (see figure 11) so that the distributor can be rotated clockwise or counter-clockwise.
2. rotate the distributor to obtain maximum RPM reading.
3. Increase engine speed to 1000 RPM and again rotate the distributor while observing RPM scale. If the engine speed can be increased by 100 RPM or more, the centrifugal advance is faulty. Repair or replace as necessary.

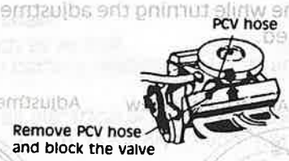
Fig. 11



F. Testing the Positive Crankcase Ventilator (PCV)

1. Remove the PCV hose and block the valve to stop all air flow.
2. Check that the idle speed drops 50 RPM or more. If idle speed does not drop or drops less than 50 RPM, the ventilator valve must be cleaned or replaced.

Fig. 12 Positive Crankcase Ventilator test



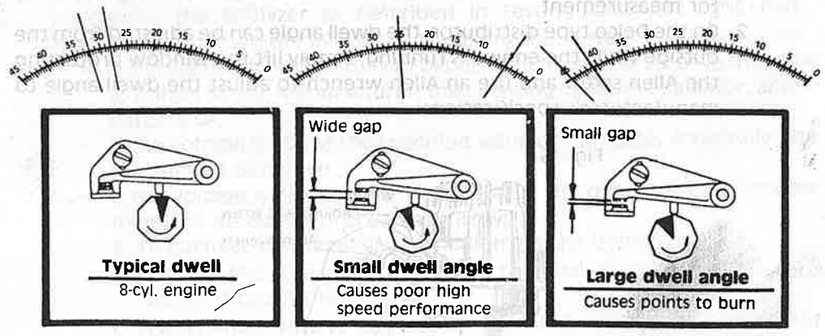
- **DWELL METER FUNCTION**

A. Definition of Dwell Angle

Dwell angle refers to the degrees or time during which the breaker points are closed in every distributor cam rotation. The closed points serve as a path for electric current flow from battery into the ignition coil so that energy can be built up to give a spark.

If the dwell angle is too small, the points gap is too wide and results in poor acceleration or high speed performance. If the dwell angle is too large, the points gap is too narrow and often causes rapid deterioration of the points.

Fig. 13



B. Connection of analyzer with an inductive pickup:

1. The black clip remained connected to battery negative (–) post.
2. Connect the red clip to the negative (–) termainal of ignition coil as described in Tachometer Function point B, 5.

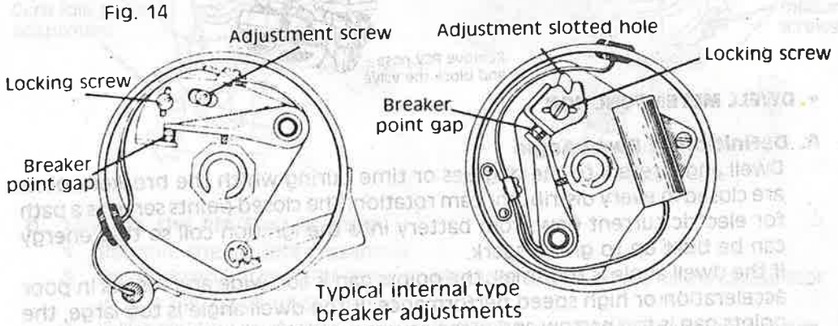
C. Connection of analyzer only with 2 test leads:

The connection remains identical as described in Tachometer Function point B, 5.

D. Adjusting the Dwell Angle:

1. Run the engine to normal working temperature, stop the engine.
2. Remove the distributor cap and rotor. Remove the high tension cable from the center tower of distributor cap and guound it.
3. Loosen the locking screw of the points.
4. Crank the engine while turning the adjustment screw until the proper dwell angle is obtained.

Fig. 14

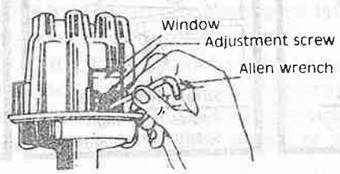


Typical internal type breaker adjustments

Note: 1. The needle may fluctuate at cranking speed, use the average reading for measurement.

2. On the Delco type distributor, the dwell angle can be adjusted from the outside while the engine is running. Simply lift the window protecting the Allen screw and use an Allen wrench to adjust the dwell angle to manufacturer's specifications.

Fig. 15



E. Testing Distributor Cam Wear:

1. Note the dwell angle at idle speed.
2. Increase engine speed to about 2000 RPM while observing the dwell angle. If the dwell angle varies more than the amount specified by the manufacturer (usually 3°), the cam is worn out or the distributor shaft is bent. Repair or replace as necessary.

• VOLTMETER FUNCTION

A. Testing Battery Leakage:

1. Connect the black clip to battery negative (–) post of the battery.
2. Move function switch to Lo-Volt position.
3. Clip a metal nail to the red clip and touch various spots on the battery while watching the meter. If it registers any reading, the battery is leaking and needs to be cleaned with baking soda and water solution.

B. Testing Battery at Light Load:

1. Move the function switch to Hi-Volt.
2. Connect the black clip to battery negative (–) post and red clip to positive (+) post.
3. Turn on headlights and all electrical accessories. Observe the meter for 2 minutes. If reading is less than 11.5V on 12-volt system or 5.7V on 6 volt system, the battery is insufficiently charged. Charge the battery and retest. If reading is still low, replace battery.

C. Testing Battery at Heavy Load:

1. Follow the first two steps under Testing Battery at Light Load.
2. Remove the high tension calbe from the center tower of distributor cap and ground it.
3. Crank the engine for 15 seconds and note the voltage. If the reading is less than 9.5V on 12-volt system or 5.7V on 6-volt system, check the starter circuit. If it is OK, recharge the battery and retest. If the reading is still low, replace the battery.

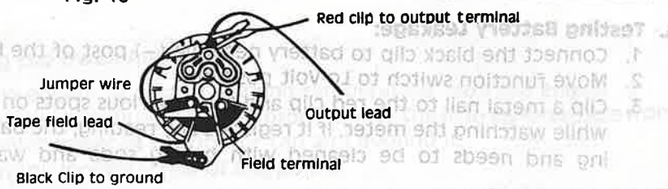
D. Testing the Charging System: (see Fig. 16)

1. Connect the analyzer as described in Testing Battery at Light Load.
2. Gradually increase the RPM while watching the meter:
   - — If the pointer climbs steadily to between 13.5 V and 15.5 V or to the value specified by the manufacturer, the charging system—regulator, alternator is OK.
   - — If the voltage is above the specified value or fluctuates erratically, the regulator is defective.
   - — If the voltage is below the specified value, the regulator or alternator might be defective, proceed as follows:
     a. Disconnect the negative (–) cable from the battery.
     b. Remove the wire from the field (F) terminal of the alternator, do not let it touch the ground.
     c. Use a jumper wire to connect the field (F) terminal of the alternator to its output (BAT) terminal. Refer to the owner's manual for more specific information.
     d. Reconnect the negative (–) battery cable, start the engine and slowly increase the RPM while watching the meter.
     — If the voltage is now above 13.5V, the regulator is defective.

Caution: perform this test as quickly as possible and do not exceed 17V.

— If the voltage is still low, the alternator is defective.

Fig. 16



E. Testing the Starter Circuit:

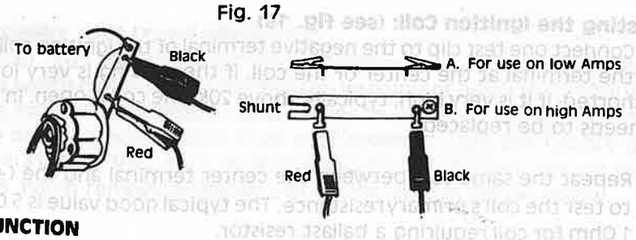
1. Remove the high tension cable form the center tower of distributor cap and ground it.
2. Move the function switch to Lo-Volt.
3. Connect the black clip to the battery negative (–) post.
   Note: If the clip is connected to the cable clamp, make sure that the contact is clean and tight before proceeding the next step.
4. Connect the red clip to the housing of the starter motor. Make sure that a good electrical contact is made.
5. Crank the engine while watching the meter. If it reads 2 volts or more, the starter motor is poorly grounded. Repair as necessary.
6. Connect the red clip to battery positive (+) post.
   Note: see step 3.
7. Connect black clip to the insulated terminal of the starter motor.
8. Crank the engine. If memter reads 2 volts or more, check for loose or dirty connections.

- **AMMETER FUNCTION**

A. Testing the Charging Current: (see Fig. 1 7)

1. Diconnect the negative (–) cable from the battery.
2. Disconnect the wire from the output (BAT) terminal of the alternator and connect the external shunt (B) between this terminal and the wire just removed.
3. Reconnect the battery cable, crank the engine several times without starting it to partially discharge the battery.
4. Start the engine, increase the RPM to about 2,000 RPM. Note the reading of the meter. If needle moves backwards, reverse test leads connections.
   —If it is within 10 AMP of the value specified by the manufacturer, the charging current is OK.
   —If it is too low, proceed to next step to determine if the regulator or the alternator is defective.
5. Refer to steps 2a, b, c under "testing the charging system" to jump the field terminal of the alternator.
6. Start engine and increase the RPM to 2000 RPM. If the current now is within the value specified, the regulator is defective; if it is still too low, the alternator is defective.

Fig. 17



- **OHMS FUNCTION**

A. Ohms-Adjust and Battery Replacement

The ohmmeter contained in model 3022 and 3032 analyzers is powered by internal batteries which are not supplied with the analyzer. Prior to initial operation, install the proper-sized batteries into the battery holder located at the back of instrument housing. Before each use of ohms function, a preliminary ohms adjustment is necessary:

A. Set function switch to Ohms position.
B. Connect the red and black clips together. Check that needle indicates "0" on the right end of ohms scale.
C. If the needle does not indicate "0" on the ohms scale, turn the ohms-adjust knob on front of case until the needle indicates "0"
D. If turning the knob fails to make the needle indicate "0", the batteries contained in the analyzer are worn and need to be replaced. Simply remove the battery compartment cover in the back of instrument housing with your fingers, and replace worn batteries. Use care when installing replacement batteries to observe correct polarity.
E. Remember to make the ohms adjustment again after batteries are replaced.

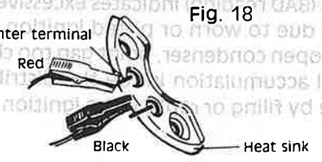
A. Testing the Continuity of Circuit:

1. Connect the suspected component to the red and black clips and observe reading:
   — If the reading is very low, the continuity exists.
   — If the reading is very high, the component is opened.

C. Testing the Diode: (see Fig. 18)

1. Connect the clips to the diode ends and note the value.
2. Reverse the connections at the diode ends and note the value.
   — The two noted values should be considerably different, one is very high and one is very low. If not, the diode is defective.

Fig. 18

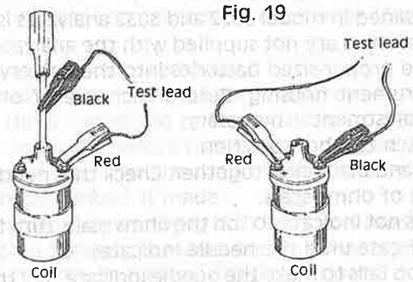


D. Testing the Ignition Coil: (see fig. 19)

1. Connect one test clip to the negative terminal of the ignition coil, the other to the terminal at the center of the coil. If the reading is very low, the coil is shorted; if it is very high, typically above 20K, the coil is open. In both cases it needs to be replaced.

2. Repeat the same test between the center terminal and the (+) terminal to test the coil's primary resistance. The typical good value is 5 Ohm or 1 Ohm for coil requiring a ballast resistor.

Fig. 19



- **POINTS FUNCTION**

Points scale is used to check excessive resistance in the ignition points which will directly affect the operation of the ignition system causing hard starting, missing and poor gasoline mileage.

A. Point Resistance Test

1. Move the function selector switch to Dwell position first.
2. Connect the black clip to a good engine ground chassis.
3. Connect the red clip to the distributor terminal of the ignition coil.
4. Remove high tension wire from the center tower of the distributor cap and ground it to prevent engine from starting.
5. Turn ignition key on.
6. Bump engine until points are closed, indicated by the needle swinging toward left side of dial.
7. Move the function selector switch to Points position.
8. With key on and points closed, the needle should move to rest within the 'OK' zone of the points scale.
   — A red reading (BAD reading) indicates excessive primary resistance and this is usually due to worn or pitted ignition points. Bad points may be caused by open condenser, point gap too close, excessive regulator voltage or oil accumulation inside the distributor etc. Always clean point surface by filing or replace the ignition points and install a new condenser.

- **REPLACEMENT TEST LEADS ASSEMBLY**

Model 3020, 3022 3030, 3031 and 3032 analyzers have a detachable test leads assembly which can be removed from the instrument housing for easy storage after use. However, should test leads or clips be damaged due to improper use, you may obtain a replacement from your dealer or from the factory specifying model 3194 for 3022, 3031 or 3032 analyzers; and 3196 for 3020 or 3030 analyzers. When removing, always pull on the plug as shown below.

Fig. 20